

Hiring and Pay Authorities for Federal Scientific and Technical (S&T) Personnel

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Summary

In recent decades, the federal government has made many efforts to recruit and retain scientists, engineers, and technical workers, who otherwise may find a more attractive environment in the private and nonfederal sectors. As a group, these science and technology (S&T) personnel may be called the federal S&T workforce. A large subset of the S&T workforce is composed of scientific and engineering (S&E) personnel. By one count, the federal government employs over 200,000 scientists and engineers.

Several factors have contributed to concerns about the federal S&T workforce. These include demand for S&T workers, concerns as to whether federal salaries are competitive with the private sector, the need for U.S. citizenship for federal employment, and the aging of the federal S&T workforce as those hired during previous federal S&T hiring “booms” retire.

Many federal S&T personnel are hired or paid under agency-specific statutory authorities, rather than government-wide civil service laws in Title 5 of the *United States Code*. Others may be hired or paid under a variety of executive-branch-wide statutory authorities which allow for, among other things, demonstration projects, direct hiring, and special pay rates.

Congress frequently has been willing to grant flexibility for expedited hiring or higher-than-usual rates of pay, in order to better equip agencies to accomplish congressionally determined public policy objectives. However, Congress frequently also has been wary of providing too much flexibility, or unaccountable flexibility, because of the potential for flexibility to be abused. Therefore, federal personnel-related laws continually raise the issue of how to balance flexibility, on one hand, with preventing abuse of the flexibility, on the other.

Human resource management issues relating to S&T personnel have been of ongoing concern to Congress, both government-wide and for particular agencies. Because hiring and pay practices are changing constantly, not only by law, but also by agency regulation and administrative action, it is not possible to provide a comprehensive overview or assessment of all policies here. Nevertheless, if Congress wishes to evaluate the ability of the federal government and its agencies to recruit and retain S&T personnel, the variety of statutory authorities provide illustrations of topics that might be examined. In addition, the federal government’s experience with these statutory authorities might inform Congress’s deliberations. For example, Congress may wish to consider modifying the ability of the federal government to recruit highly-qualified scientific, engineering, and technical personnel.

In evaluating current efforts or considering future modifications, Congress may wish to consider options that include agency-specific or executive-branch-wide approaches; leveraging the involvement of the Office of Personnel Management, the Office of Science and Technology Policy, the federal Chief Human Capital Officers Council, or other entities; requiring agencies to engage in strategic planning, evaluation, or other activities; and exploring a variety of S&T personnel issues in specific agency and policy contexts.

This report will be updated when events warrant.

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Technically, there is a single “civil service” for the federal government.¹ Many federal employees work under the broad framework of requirements in Title 5 of the *United States Code* (hereafter, Title 5). However, many laws and rules that cover the civil service have been customized to subsets of federal employees. That is, agencies and groups of employees have been “carved out” from government-wide provisions in Title 5 in areas like hiring, pay, performance appraisal, and labor-management relations. These subsets of employees may be broken down, for example, by branch of government, agency, and occupation. In addition, the civil service system has become increasingly decentralized in execution.² Agencies also use discretion to create subtle or significant differences within the systems they establish to manage employees. As a result of these trends, the civil service has become increasingly fragmented in recent decades.³ At the same time, it has become more difficult for the Office of Personnel Management (OPM) and stakeholders to comprehensively monitor and oversee developments related to human capital management (HCM) across the federal government.⁴

Fragmentation has been evident not only in law, but also is apparent in the data for federal scientific and technical (S&T) personnel. (See **Box 1**.) In recent decades, the federal government has made many efforts to recruit and retain scientists, engineers, and technical workers, who otherwise may find a more attractive environment in the private and nonfederal sectors. As a group, these S&T personnel may be called the federal S&T workforce.⁵ A large subset of the S&T workforce is composed of scientific and engineering (S&E) personnel.

This report provides an illustrative overview of statutory authorities relating to the hiring of, and pay for, federal S&T personnel. Some authorities are government-wide, and others are specific to particular agencies. Because hiring and pay practices are changing constantly, not only by law, but also by agency regulation and administrative action, it is not possible to provide a comprehensive overview or assessment of all policies here. Nonetheless, the report may inform Members of Congress who wish to consider modifying the ability of the federal government to recruit highly-qualified scientific, engineering, and technical personnel. Before examining these statutory authorities, the report begins with a discussion of what kinds of employees are in the federal S&T and S&E workforces. The report then analyzes several key factors that are affecting the S&T workforce, both overall in the United States and in the federal government.

What Is a Federal “Workforce”?

The many ways in which federal employees can be described and categorized are illustrative of the fragmentation of the federal scientific and technical workforce, and sometimes cause confusion among human resources practitioners and observers. Therefore, some discussion of

¹ By law, the federal “civil service consists of all appointive positions in the executive, judicial, and legislative branches of the Government of the United States, except positions in the uniformed services” (5 U.S.C. § 2101).

² Performance of certain functions, such as examining employees being considered for hiring, has been delegated to executive agencies by the Office of Personnel Management, especially since 1978 (Civil Service Reform Act of 1978, P.L. 95-454).

³ The terms “customized,” “fragmented,” and “decentralized” are used in this report as synonyms. Observers sometimes use the terms to portray the underlying trend in a positive or negative light.

⁴ An illustration of this difficulty arguably is reflected by the literature on the subject. A book written in the late 1950s, though dated, still is widely considered the best history of the federal civil service. See Paul P. Van Riper, *History of the United States Civil Service* (Evanston, IL: Row, Peterson, and Company, 1958). For an overview, see “Title 5: The Federal Civil Service,” by Barbara L. Schwemle, in CRS Report RL30795, *General Management Laws: A Compendium*, by Clinton T. Brass et al.

⁵ Both versions of the “S&T” acronym are treated in this report as synonymous.

uses of this term is provided here. Specifically, federal employees may be categorized as being situated in multiple, overlapping “workforces.” For example, employees may be described in terms of the organizational units in which they hold positions (e.g., Department of Energy workforce). In addition, employees oftentimes are described and categorized according to distinct skill sets that they use in their jobs (e.g., scientific and engineering workforce).

Other examples of the latter usage include the acquisition, information technology, and human resources workforces. These categories of employees have been referred to colloquially as “functional workforces” or “occupations.” Employees in one of these workforces may work within one agency or across several agencies. Still further ways of categorizing employees relate to how they are hired (“appointed”) and paid. Because the procedures for hiring and paying employees frequently are specified in statute and regulation, a workforce may be referred to as corresponding to a certain section of the *United States Code* or part of the *Code of Federal Regulations*. Congress frequently legislates using all of these conceptions of workforces.⁶

Who Is Included in the Federal Science and Engineering (S&E) Workforce?

Fragmentation is also evident in the ways in which the S&E workforce is categorized, whether broadly as a scientists or engineer, or by sub-occupation categories such as a life scientist or electrical engineer. The S&E workforce can also be delineated by agency, work activity, educational degree, age, and geographic region. These characteristics influence federal employment policies.

The National Science Foundation (NSF) provides information on the federal S&E workforce, based on OPM data. **Table 1** provides an overview of this workforce by major occupational group, in order of the most populous group. As shown here, the occupation in which the largest number of scientists is employed is the computer and mathematical sciences. It is also perhaps telling that the plurality of engineers are in the “other engineers” category.

Federal S&E personnel also may be categorized in terms of the work they conduct. **Table 2** provides the primary work activity of federal scientists and engineers. As shown here, federal scientists and engineers work on a wide variety of activities in the federal government. For those whose work activity is known, the largest pool of federal scientists and engineers work in research and in development.

Box 1. Who Should Be Included in the U.S. S&T Workforce?

Determining the number of employees in the U.S. S&T workforce can be challenging because of definitional issues. At the workforce’s core are scientists and engineers, but estimates can vary based on whether or not the estimate includes those in defined S&E occupations, in related S&E occupations (e.g., pre-college teachers, managers, technicians), who use S&E knowledge (e.g., patent lawyers, doctors, health professionals), or who have at least one degree in S&E or an S&E-related fields.^a Using these varying definitions, U.S. S&T workforce estimates are developed by the National Science Foundation (NSF)/National Science Board (NSB), the Bureau of Labor Statistics (BLS), and the U.S. Census Bureau. Each has different definitions of who should be included in the S&T workforce. Estimates can also vary depending on the data used.

Most estimates focus only on the U.S. S&E workforce as opposed to the entire U.S. S&T workforce, but S&E estimates vary as well. NSB indicates that, depending on the definition and perspective used, the size of the S&E

⁶ For example, see 10 U.S.C. §§ 1701-1761 (Defense acquisition workforce) and 41 U.S.C. § 433 (civilian agency acquisition workforces).

workforce varied between approximately 5.0 million and 21.4 million individuals in 2006—approximately 4-15% of all employed civilians in the United States (144.4 million^b). For example, one NSF analysis finds that, in 2006, 5.0 million of the 18.9 million employed scientists and engineers worked in S&E occupations, 5.2 million worked in S&E-related occupations, and 8.7 million worked in non-S&E-related occupations.^c

NSB suggests that the most relevant S&E workforce estimates may be either 17.0 million, which in 2006 was the number of individuals who had at least one degree in an S&E field, or 21.4 million, which includes both these individuals plus those with a degree in an S&E-related field such as health or technology—as it reflects the many ways science and technical knowledge is used in the United States.^a The number of federal scientists and engineers in 2005 was 209,747,^d approximately 1% of the total U.S. S&E workforce.

Sources:

a. National Science Board, *Science and Engineering Indicators 2008*, Chapter 3 (Arlington, VA: National Science Foundation, 2008), <http://www.nsf.gov/statistics/seind08/pdf/c03.pdf>.

b. U.S. Census Bureau, *Statistical Abstract of the United States: 2008*, Table 583 (Washington, DC: Government Printing Office, 2008), <http://www.census.gov/compendia/statab/>.

c. National Science Foundation, “Unemployment Rate of U.S. Scientists and Engineers Drops to Record Low 2.5% in 2006,” NSF 08-235, April 2008, <http://www.nsf.gov/statistics/infbrief/nsf08305/>.

d. Steven Proudfoot, *Federal Employment of Scientists and Engineers Remained Steady from 2003 to 2005*, NSF 09-312, March 2009, <http://www.nsf.gov/statistics/infbrief/nsf09312/#fn1>.

Table 3 provides an overview of the number of federal S&Es employed, by agency, beginning with the agency that employs the most S&Es. As shown here, the Department of Defense (DOD) employs the most federal S&Es, almost half of the total federal S&E workforce.

Table 4 provides information on the degree level of federal S&Es. The bachelor’s degree is the highest degree obtained for the majority of the federal S&E workforce. In engineering, those at the PhD level are a smaller percentage of that occupation’s workforce than is the case for those in science occupations.

Table 5 provides the geographic location of this workforce, broken down by region, which is located throughout the United States. As shown here, the South Atlantic region (which includes, among other states and geographic areas, the District of Columbia, Virginia, and Maryland) has the most scientists and engineers. The next most numerous region is the Pacific region. The lowest number are located in the West North Central and New England areas.

Table 1. Federal Scientists and Engineers, by Major Occupational Group
2005

Major Occupational Group	Number
Federal scientists, by major occupational group	
• Computer and mathematical scientists	41,922
• Life scientists	35,351
• Physical scientists	23,876
• Social scientists	22,262
<i>Subtotal</i>	<i>123,411</i>
Federal engineers, by major occupational group	

Major Occupational Group	Number
• Electrical, electronics, and computer engineers	27,060
• Civil engineers	10,247
• Mechanical engineers	9,701
• Aerospace engineers	8,292
• Industrial engineers	1,624
• Chemical engineers	1,090
• Other engineers	28,322
<i>Subtotal</i>	86,336
Total number of federal scientists and engineers	209,747

Source: Adapted from Steven Proudfoot, *Federal Employment of Scientists and Engineers Remained Steady from 2003 to 2005*, NSF 09-312, March 2009, <http://www.nsf.gov/statistics/infbrief/nsf09312/#fn1>.

Notes: NSF tabulations from data provided by OPM and the Defense Manpower Data Center.

Table 2. Federal Scientists and Engineers, by Primary Work Activity
2005

Primary work activity	Number
Development	19,770
Research	19,430
Natural resources operations	16,359
Other, not elsewhere classified	15,981
Data collection, processing, and analysis	13,944
Management	9,810
Design	9,777
Installations, operations, and maintenance	8,130
Test and evaluation	7,713
Regulatory enforcement and licensing	6,332
Clinical practice, counseling, and ancillary medical services	5,343
Technical assistance and consulting	4,523
Planning	4,446
Scientific and technical information	4,443
Construction	4,061
Production	2,178
Standards and specifications	1,241
Research contract and grant administration	1,100
Teaching and training	422
Activity unknown	54,744
Total number of federal scientists and engineers	209,747

Source: Adapted from Table 2 in National Science Foundation, Division of Science Resources Statistics, 2008, *Federal Scientists and Engineers: 2003–05*, Detailed Statistical Tables NSF 09-302, Arlington, VA, <http://www.nsf.gov/statistics/nsf09302/>.

Table 3. Federal Scientists and Engineers, by Agency
2005

Agency	Number
Department of Defense	93,892
Department of Agriculture	20,407
Department of the Interior	14,933
Department of Health and Human Services	11,541
Department of Commerce	11,293
National Aeronautics and Space Administration	11,133
Environmental Protection Agency	9,761

Agency	Number
Department of Veterans Affairs	7,961
Department of Transportation	6,011
Department of Energy	4,454
Department of Justice	2,663
Department of Labor	2,386
Department of State	1,814
Nuclear Regulatory Commission	1,534
Department of the Treasury	938
General Services Administration	841
National Science Foundation	510
Department of Housing and Urban Development	313
U.S. International Development Cooperation Agency	181
All other agencies	7,181
Total number of federal scientists and engineers	209,747

Source: Adapted from Steven Proudfoot, *Federal Employment of Scientists and Engineers Remained Steady from 2003 to 2005*, NSF 09-312, March 2009 at <http://www.nsf.gov/statistics/infbrief/nsf09312/#fn1>.

Notes: NSF tabulations from data provided by OPM and the Defense Manpower Data Center. The total number of federal scientists and engineers in 2005 was 209,747.

Table 4. Federal Scientists and Engineers, by Highest Degree
2005

Highest Degree	Number
All federal scientists, by highest degree	
• Bachelor's	62,840
• Master's	36,760
• Doctorate	22,677
• Professional	1,134
<i>Subtotal</i>	<i>123,411</i>
All federal engineers, by highest degree	
• Bachelor's	58,239
• Master's	23,555
• Doctorate	4,175
• Professional	367
<i>Subtotal</i>	<i>86,336</i>
All federal scientists and engineers, by highest degree	
• Bachelor's	121,079
• Master's	60,315

Highest Degree	Number
• Doctorate	26,852
• Professional	1,501
Total	209,747

Source: Adapted from Table 5-5 in National Science Foundation, Division of Science Resources Statistics, 2008, *Federal Scientists and Engineers: 2003–05*, Detailed Statistical Tables NSF 09-302, Arlington, VA, <http://www.nsf.gov/statistics/nsf09302/>.

Notes: Professional degree signifies completion of academic requirements for selected professions such as dentistry (DDS or DMD), law (LLB or JD), medicine (MD), theology (BD), veterinary medicine (DVM), and chiropractic or podiatry (DSC).

Why Are Some Policymakers Concerned about the Federal Science and Technology (S&T) Workforce?

Several key factors, reflective of the fragmented nature of federal S&T workforce, have contributed to policymakers' concerns about it. These factors, which can vary a great deal by the characteristics of a given population within the workforce, include the demand for S&T workers in the broader labor market; concerns about whether federal salaries are competitive with the private sector for these workers; the need for U.S. citizenship for federal employment; and the aging of the federal S&T workforce as those hired during previous federal S&T "booms" retire. More information on each is provided below.

Table 5. Federal Scientists and Engineers, by Geographic Division
2005

Geographic division	Number of scientists and engineers
• South Atlantic	86,591
• Pacific	30,816
• Mountain	18,590
• East North Central	15,279
• West South Central	14,712
• Middle Atlantic	13,945
• East South Central	11,331
• West North Central	8,202
• New England	7,178
• Other	3,103
Total	209,747

Source: Adapted from Steven Proudfoot, *Federal Employment of Scientists and Engineers Remained Steady from 2003 to 2005*, NSF 09-312, March 2009 at <http://www.nsf.gov/statistics/infbrief/nsf09312/#fn1>.

Notes: Individuals in U.S. territories or with location unknown are included in total but not shown separately. Geographic divisions are defined in the NSF report as follows. New England: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont; Middle Atlantic: New Jersey, New York, Pennsylvania; East North Central: Illinois, Indiana, Michigan, Ohio, Wisconsin; West North Central: Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota; South Atlantic: Delaware, District of Columbia, Florida, Georgia,

Maryland, North Carolina, South Carolina, Virginia, West Virginia; East South Central: Alabama, Kentucky, Mississippi, Tennessee; West South Central: Arkansas, Louisiana, Oklahoma, Texas; Mountain: Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming; Pacific: Alaska, California, Hawaii, Oregon, Washington.

Current Demand

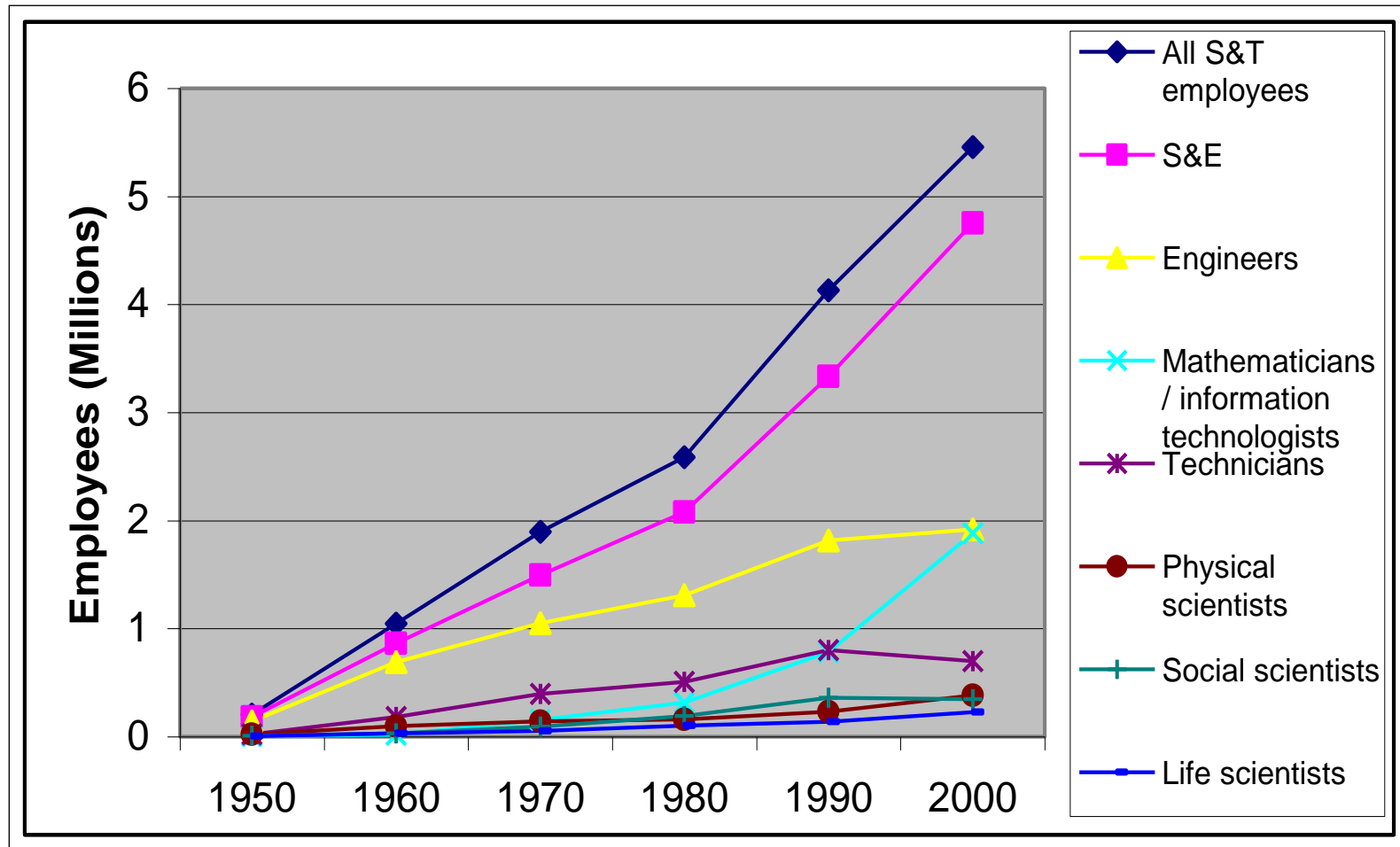
When demand for a particular type of S&T expertise is high, private sector salaries for individuals may increase, as may the speed with which individuals are hired. This may make it more challenging for the federal government to compete for employment of those individuals.

The number of S&T workers in the U.S. workforce has increased both overall and relative to the general workforce. The number of workers in S&T occupations—workers in S&E occupations plus technicians and programmers—grew at a 6.8% average annual rate between 1950-2000 (see **Figure 1**), according to the National Science Board (NSB).⁷ From 1950 to 2000, the number of S&T employees increased from approximately 0.2 million in 1950 to 5.5 million in 2000. Although the U.S. economic downturn may influence this overall rate of change, an NSB analysis found that workforce demand varied greatly by occupation. The analysis also found major changes over time, both positive and negative, within occupations. For example, economic downturns in 1992 (as illustrated in **Figure 1**) and 2002 may have led to a leveling off of S&E occupation employment in some S&E fields, while others increased.

⁷ National Science Board, *Science and Engineering Indicators 2008*, Chapter 3 (Arlington, VA: National Science Foundation, 2008) at <http://www.nsf.gov/statistics/seind08/pdf/c03.pdf>.

Figure 1. Science and Technology Employment

1950-2000



Source: National Science Board, Science and Engineering Indicators 2008, Figure 3-1 (Arlington, VA: National Science Foundation, 2008), <http://www.nsf.gov/statistics/seind08/pdf/c03.pdf>.

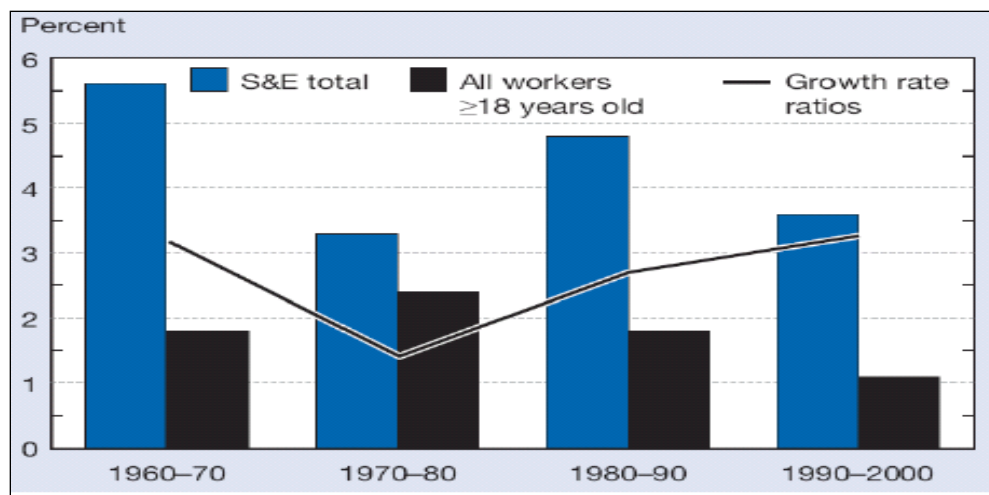
Notes: Data include bachelor's degrees or higher in science occupations, some college and above in engineering occupations, and any education level for technicians and computer programmers.

In addition, the rate of growth of S&T workers is higher than that for all workers in the United States. **Figure 2** takes the major influence on the number of workers in S&T occupations, those in S&E occupations, and compares the average annual growth rate of these workers to that of all workers.⁸ As shown here, the average annual growth rate for S&E occupations was consistently higher than that for all workers from 1960-2000.

Supply

For all S&E fields, employment has grown faster than domestic degree production. As shown in **Figure 3**, while the number of workers in S&E occupations grew at an average annual rate of 4.2% from 1980-2000 (see left-hand group of columns, fifth column), the domestic S&E degree production grew at a lower rate of 1.5% (left-hand group of columns, fourth column).⁹ According to the NSB, the marketplace responded to that difference between degree and occupation growth by employing individuals in S&E occupations who did not have S&E degrees, or foreign S&E workers (who may have foreign S&E degrees).

Figure 2. Average Annual Growth Rate of S&E Occupations Versus All Workers
1960-2000



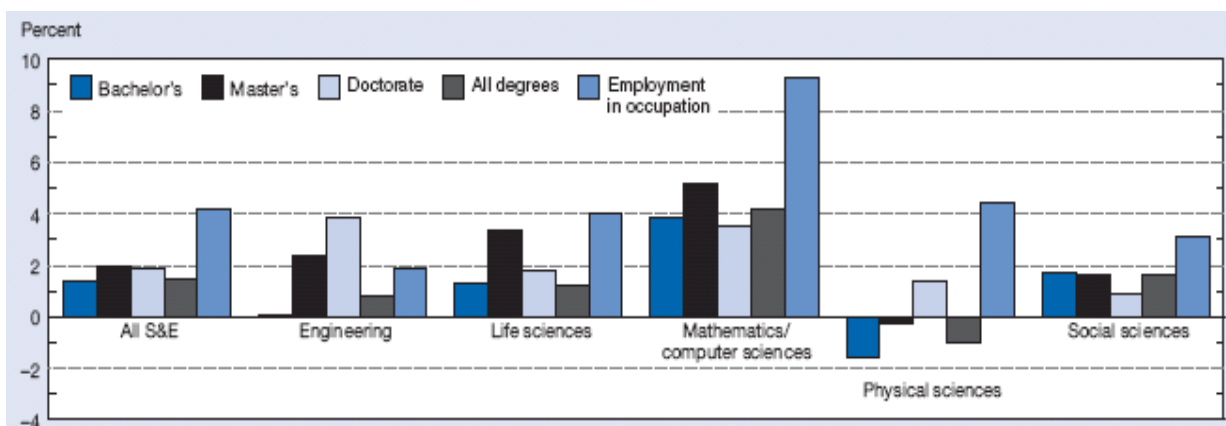
Source: National Science Board, *Science and Engineering Indicators 2008*, Figure 3-2 (Arlington, VA: National Science Foundation, 2008), <http://www.nsf.gov/statistics/seind08/pdf/c03.pdf>.

⁸ Ibid.

⁹ Ibid.

Figure 3. Annual Average Growth Rate of Degree Production and Occupational Employment, by S&E Field

1980-2000



Source: National Science Board, *Science and Engineering Indicators 2008*, Figure 3-3 (Arlington, VA: National Science Foundation, 2008), <http://www.nsf.gov/statistics/seind08/pdf/c03.pdf>.

Future Demand

Future demand for S&T workers is uncertain. However, Bureau of Labor Statistics (BLS) estimates indicate that demand for S&T workers in a number of fields is expected to increase at a greater rate than for the overall workforce. BLS projection data indicates that health care practitioners and technicians will add the most new jobs (1.4 million; 19.8% increase) and computer and mathematical occupations will grow the most quickly (0.8 million jobs; 24.8% increase).¹⁰ BLS expects other occupational groups related to science and engineering to grow as well, including architecture and engineering (0.3 million jobs; 10.4% growth rate), and life, physical, and social sciences (0.2 million jobs; 14.4% increase). Of the 30 fastest growing occupations, with an increase of 27% compared to the 10% average for all the occupations, many are science and technology-related.¹¹

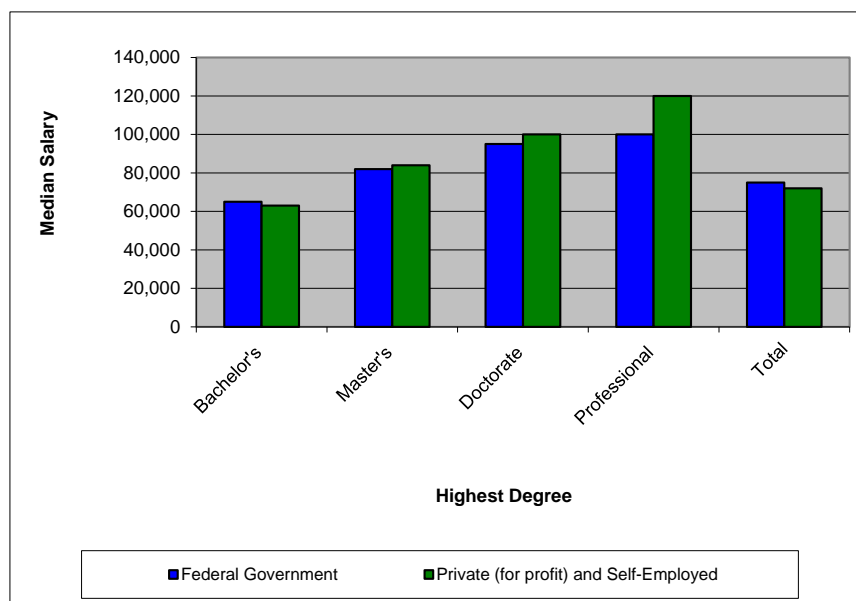
Salary

Some observers may also be concerned whether the salaries provided by the federal government to scientists and engineers are sufficiently competitive. As shown in **Figure 4**, disparities may exist at higher degree levels between federal government and private, for-profit salaries. Such comparisons, however, do not necessarily account for other factors that may influence salaries, such as experience and field of work. **Figure 5** identifies several fields where private sector salaries are higher than federal government salaries for those holding PhD degrees.

¹⁰ Bureau of Labor Statistics, Office of Occupational Statistics and Employment Projections, *Employment Outlook: 2006—16: Occupational Employment Projections to 2016*, November 2007, <http://www.bls.gov/opub/mlr/2007/11/art5full.pdf>.

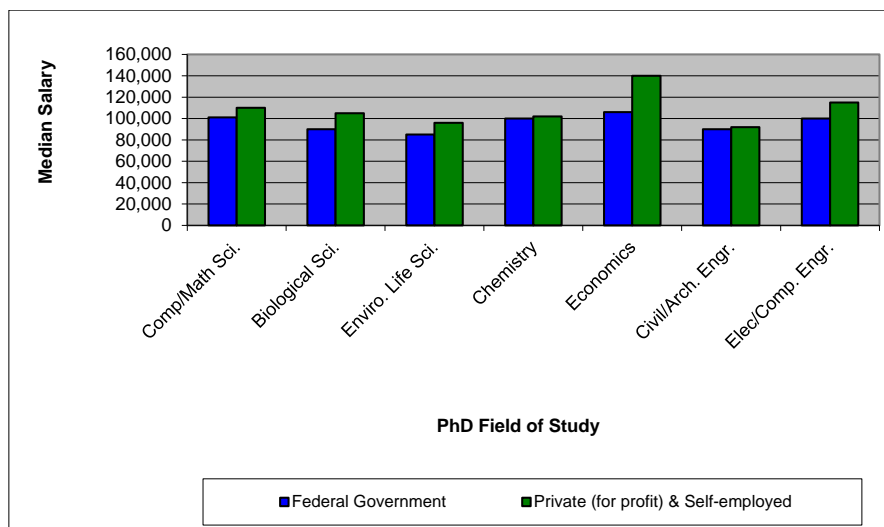
¹¹ Bureau of Labor Statistics, Office of Occupational Statistics and Employment Projections, *2008-2009 Occupational Outlook Handbook*. See Table 1. The 30 fastest growing occupations covered in the 2008-2009 Occupational Outlook Handbook at <http://www.bls.gov/news.release/ooh.t01.htm>. The full handbook provides more specific information, by occupation, and is available at <http://www.bls.gov/OCO/>.

Figure 4. Comparison of Full-Time Science and Technology Worker Salaries, by Employment Sector
2006



Source: National Science Foundation/Division of Science Resources Statistics, Scientists and Engineers Statistical Data System (SESTAT): 2006. Tabulations prepared by NSF for the Congressional Research Service.

Figure 5. Comparison of Salaries for Select PhD Fields of Study, By Employment Sector
2006



Source: National Science Foundation/Division of Science Resources Statistics, Scientists and Engineers Statistical Data System (SESTAT): 2006. Tabulations prepared by NSF for the Congressional Research Service.

Notes: "Comp/Math Sci." includes computer science, information science, mathematics, and statistics; "Bio. Sci." includes the biological sciences; "Enviro. Life Sci." includes the environmental life sciences; Chemistry does not include biochemistry; "Civil/Arch. Engr." includes civil and architectural engineering; and "Elec/Comp. Engr." includes electrical and computer engineering.

U.S. Citizenship

The issue of U.S. citizenship is sometimes cited as a reason why some federal agencies—particularly those whose mission includes national defense, national security, and similar fields—have difficulty filling positions.¹² On the other hand, a 2004 Rand Science and Technology Policy Institute found that

Although the proportion of STEM workers who require security clearances (and hence citizenship) may increase due to national defense and homeland security concerns, the actual numbers of such jobs are very small compared with the federal STEM workforce and with the number of STEM workers in the national workforce who are citizens. We do not foresee a shortage of STEM-trained citizens eligible for security clearance.¹³

Enrollment of U.S. citizens in graduate science and engineering programs has not kept pace with that of foreign students in those programs. According to NSF, while the first-time, full-time science and engineering graduate enrollment of foreign students in science and engineering fields increased by 16% from 2005 to 2006, U.S. citizen and permanent resident enrollment increased by slightly more than 1%.¹⁴

As shown in **Table 6**, graduate enrollment by U.S. citizens in several fields including computer science, mathematical science, and the physical sciences decreased from 2005 to 2006. Further, for some of the PhD fields of study discussed in the previous section where there is a pay differential between the federal government and private sector, the majority of PhD recipients in those fields are foreign students. According to the NSB, foreign students on temporary visas earned half or more of PhD degrees awarded in engineering, mathematics, computer sciences, physics, and economics in 2005.¹⁵ This further limits the number of recent PhD graduates available for employment by federal agencies. According to OPM,

The Federal Government gives strong priority to hiring United States citizens and nationals, but non-citizens may be hired in certain circumstances. Agencies considering non-citizens for Federal employment in the competitive service must follow usual selection procedures and also meet the requirements of all three of the following: immigration law; an appropriations act ban on paying certain non-citizens; and an executive order restriction on appointing non-citizens in the competitive service. In addition, agencies are responsible for applying any citizenship requirements that may appear in their individual agency's authorization and appropriation laws.¹⁶

Aging Workforce

Another key issue for government is the aging workforce. As shown in **Figure 6**, while the number of federal S&Es is decreasing in the 35-39 and 40-44 year old age groups, the number of

¹² See, for example, “DHS Official Warns U.S. Workforce Faces Skills ‘Crisis’,” *CongressDaily*, June 16, 2008.

¹³ William P. Butz, Terrence K. Kelly, David M. Adamson, Gabrielle A. Bloom, Donna Fossum, and Mihal E. Gross, *Will the Scientific and Technology Workforce Meet the Requirements of the Federal Government?*, Rand Corporation, Science and Technology Policy Institute, 2004, <http://www.rand.org/pubs/monographs/MG118/index.html>.

¹⁴ National Science Foundation, *First-Time, Full-Time Graduate Student Enrollment in Science and Engineering Increases in 2006, Especially Among Foreign Students*, NSF08-302, InfoBrief, December 2007, <http://www.nsf.gov/statistics/infbrief/nsf08302/>; and Eugene McCormack, “Number of Foreign Students Bounces Back to Near-Record High,” *The Chronicle of Higher Education*, vol. 54, November 16, 2007, p. A1.

¹⁵ National Science Board, *Science and Engineering Indicators 2008* (Arlington, VA: National Science Foundation, 2008), <http://www.nsf.gov/statistics/seind08/pdf/c03.pdf>.

¹⁶ Office of Personnel Management, “Laws, Regulations & Other Guidance: Citizenship Requirements for Employment,” http://www.opm.gov/hr_practitioners/lawsregulations/citizenship/index.asp.

S&Es above the age of 45 is increasing. These older individuals represent almost 60% of all federal scientists and engineers, with this percentage consistently increasing over previous years. Between 2003 and 2005, the number of federal scientists and engineers who were between 35-39 years of age decreased by 12.9%, and those from 40-44 years of age by 5.4%. When looked at more broadly, as illustrated in **Figure 7**, the majority of the federal science and engineering workforce are over 45 years of age. The number of federal scientists and engineers over 45 years of age is increasing, while those below 45 years of age is decreasing.

At some agencies, more than 50% of these employees are eligible for retirement in the next five years. To respond to this concern, some federal agencies have undertaken initiatives to increase their workforces. For example, **Figure 8** identifies the occupational categories that the Department of Commerce (DOC) has identified as mission critical, and where high turnover rates are expected. In response, the DOC has undertaken initiatives at the U.S. Patent and Trademark Office to recruit patent examiners.

Table 6. First-time, Full-time Graduate Enrollment in Science and Engineering Fields, by Field and Citizenship
2002–2006

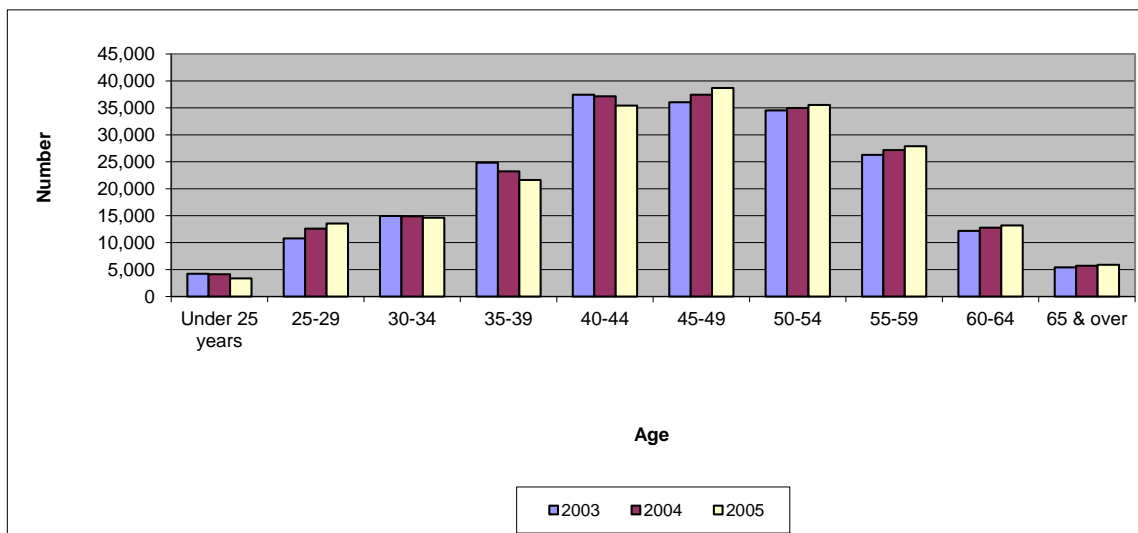
Field	U.S. citizens and permanent residents						Temporary visa holders					
	2002	2003	2004	2005	2006	% change 2005–06	2002	2003	2004	2005	2006	% change 2005–06
Science												
<i>Agricultural sciences</i>	1,856	1,971	1,870	1,828	1,764	-3.5	464	453	446	432	442	2.3
<i>Biological sciences</i>	9,261	9,763	9,808	9,925	9,946	0.2	2,866	2,956	2,988	2,993	3,109	3.9
<i>Computer sciences</i>	3,534	3,891	3,632	3,632	3,382	-6.9	5,503	4,243	4,151	4,626	5,601	21.0
<i>Earth, atmospheric, and ocean sciences</i>	2,548	2,573	2,468	2,270	2,289	0.8	537	531	458	488	506	3.7
<i>Mathematical sciences</i>	2,311	2,527	2,632	2,561	2,522	-1.5	1,607	1,658	1,620	1,635	1,820	11.3
<i>Physical sciences</i>	3,775	4,091	4,026	4,138	4,045	-2.2	2,505	2,750	2,577	2,519	2,581	2.5
<i>Psychology</i>	7,902	8,285	8,944	9,800	9,645	-1.6	518	573	534	558	579	3.8
<i>Social sciences</i>	12,689	14,285	14,285	15,098	15,638	3.6	4,344	4,352	4,101	4,162	4,668	12.1
Engineering	10,749	12,263	11,188	10,905	11,747	7.7	13,858	12,166	10,837	11,468	14,129	23.2
All science and engineering	54,625	59,649	58,853	60,157	60,978	1.4	32,202	29,682	27,712	28,881	33,435	15.8

Source: Julia Oliver, First-Time, Full-Time Graduate Student Enrollment in Science and Engineering Increases in 2006, Especially Among Foreign Students, NSF 08-302, December 2007 at <http://www.nsf.gov/statistics/infbrief/nsf08302/>.

Notes: Data is from National Science Foundation/Division of Science Resources Statistics, Survey of Graduate Students and Postdoctorates in Science and Engineering.

Figure 6. Federal Scientists and Engineers, by Age

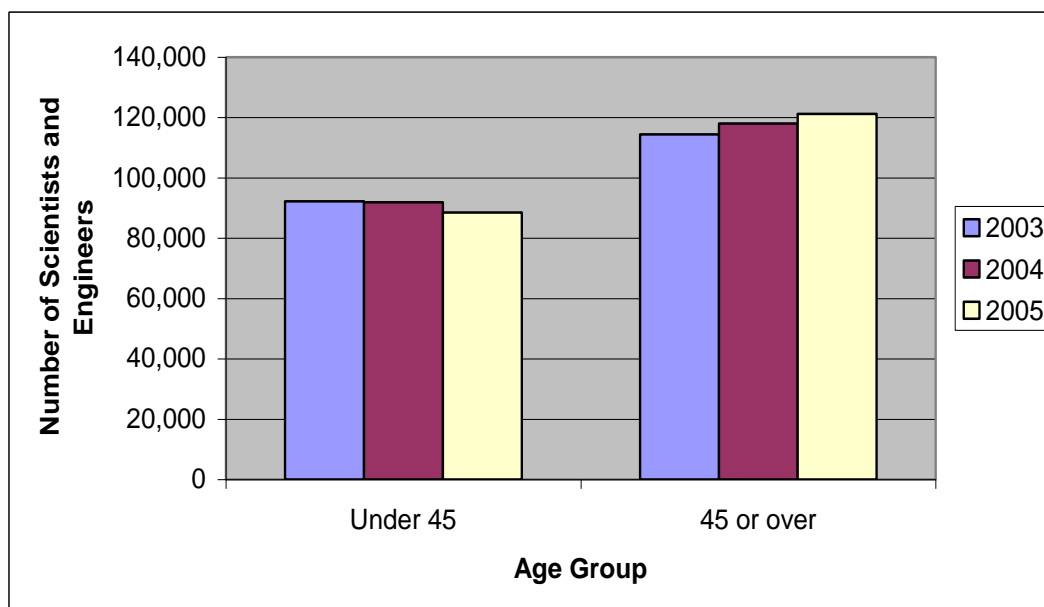
2003-2005



Source: National Science Foundation (NSF) tabulations from data provided by the Office of Personnel Management (OPM) and the Defense Manpower Data Center. Special tabulations prepared by NSF for the Congressional Research Service.

Figure 7. Federal Scientists and Engineers, By Broad Age Group

2003-2005



Source: National Science Foundation (NSF) tabulations from data provided by the Office of Personnel Management (OPM) and the Defense Manpower Data Center. Special tabulations prepared by NSF for the Congressional Research Service.

Figure 8. Occupational Categories Identified by the Department of Commerce as Possible Areas of Concern Due to High Turnover Rates Caused by Retirements

OCCUPATION	SERIES	OCCUPATION	SERIES
Economist	0110	Physical Science	1301
Human Resources Specialist	0201	Physicist	1310
Misc. Administration & Program	0301	Hydrologist	1315
Management and Program Analyst	0343	Chemist	1320
Fish Biology	0482	Meteorologist	1340
Accounting & Budget	0500	Oceanographer	1360
Electronics Engineer	0855	Mathematical Statistician	1529
Attorney	0905	Statistician	1530
General Business and Industry	1101	Computer Science	1550
Acquisition	1102	General Inspection, Investigation, and Compliance	1801
Trade Specialist	1140	Information Technology Management	2210
Patent Examiner	1224		

Source: U.S. Department Of Commerce, Office Of Human Resources Management, *FY 2008 – 2013 Strategic Plan, Turning Ideas Into Action: A Blueprint For The Future*, http://hr.commerce.gov/s/groups/public/@doc/@cfoasa/@ohrm/documents/content/dev01_006556.pdf.

Notes: The identified series is the OPM classification for the position.

What Statutory Authorities are Available for the Hiring and Pay of Federal S&T Personnel?

As noted at the beginning of this report, the federal civil service system has become increasingly fragmented in recent decades. The next two sections are included to provide context for this complexity and to help explain the configuration of statutory authorities that relate to hiring and pay of the federal government's S&T workforce. The two sections briefly outline developments relating to statutory authorities that are (1) executive-branch-wide and (2) agency-specific in nature.

Executive-Branch-Wide Statutory Authorities

Two major acts, the Pendleton Act of 1883 and the Civil Service Reform Act of 1978 (CSRA), provide a basis for understanding the evolution of statutory authorities related to the federal government's S&T workforce.¹⁷ (See **Box 2**.) Among other things, the Pendleton Act, CSRA, and other laws may serve as guideposts to a long-term issue that Congress has confronted when legislating on the topics of hiring and pay for federal employees. On one hand, Congress frequently has been willing to grant flexibility for expedited hiring or higher-than-usual rates of pay, in order to better equip agencies to accomplish congressionally determined public policy

¹⁷ Respectively, 47th Congress, 22 Stat. 403; and P.L. 95-454; 92 Stat. 1111. A comprehensive treatment of this subject is not within the scope of this report. Therefore, this section is necessarily selective in discussing developments.

objectives.¹⁸ On the other hand, however, Congress frequently has been wary of providing too much flexibility, or unaccountable flexibility, because of the potential for flexibility to be abused (e.g., hiring or pay decisions being based on considerations other than merit or achievement of congressionally determined public policy objectives).¹⁹ Therefore, federal personnel-related laws continually raise the issue of how to balance providing flexibility, on one hand, with preventing abuse of the flexibility, on the other.

CSRA and other laws, including the Federal Employees Pay Comparability Act of 1990 (FEPCA)²⁰ provided government-wide statutory authorities that are relevant to the federal S&T workforce. Taken together, these laws provide authorities that federal agencies may utilize to enhance their ability to recruit and retain highly qualified and effective workforces. The executive-branch-wide authorities that are discussed here include appointment of high-level scientific and professional (“ST”) personnel; demonstration projects; intergovernmental mobility; critical pay authority; recruitment, relocation, and retention incentives; special pay rates; and direct hire authority.

¹⁸ For example, the Classification Act of 1949 (63 Stat. 954) established “supergrades” along with the General Schedule. Specifically, the act established “grades of difficulty and responsibility of work” between GS-1 and GS-15, with the latter being more highly paid than the former. The act also added what became known as “supergrades” to this schedule, providing for the grades GS-16, GS-17, and GS-18. The supergrades ultimately were the foundation for the Senior Executive Service (SES), established by the Civil Service Reform Act of 1978 (P.L. 95-454), and were abolished by the Federal Employees Pay Comparability Act of 1990 (FEPCA; Section 529 of Title V, P.L. 101-509). Additional artifacts of the supergrades include certain senior-level positions classified above GS-15 pursuant to 5 U.S.C. § 5108 and scientific or professional positions established under 5 U.S.C. § 3104.

¹⁹ For example, in 1961, Congress amended the Classification Act of 1949 to restrict how many supergrade appointments could be made, saying “the public interest requires that effective limitations and controls be established and maintained with respect to the allocation of positions—whether by law or by administrative action—to grades 16, 17, and 18 of the Classification Act of 1949—the so-called top grades below the Federal executive level in the Government service—in order to prevent the unwarranted allocation of positions to such grades and to promote efficiency and economy in the operation of the Government” (P.L. 87-367, Section 101(a)(1); 75 Stat. 785).

²⁰ P.L. 101-509; 104 Stat. 1427, at 1444. FEPCA was included as a general provision in Title V of the Treasury, Postal Service and General Government Appropriations Act, 1991 (104 Stat. 1389).

Box 2. Balancing Accountability and Flexibility: A Historical Perspective

Following the Civil War, there were twenty years of effort to establish a civil service for the executive branch that would replace the “spoils system,” under which a political party gave federal jobs to its favored candidates. These efforts culminated with enactment of the Pendleton Act of 1883, which gradually replaced the spoils system with a civil service based on law. Among its features were competitive examinations for merit-based hiring, relative security of tenure, and political neutrality. The Civil Service Reform Act of 1978 (CSRA) was the first comprehensive revision of the Pendleton Act.

Development of what eventually became the CSRA largely was begun in the Jimmy Carter Administration. A group of political appointees and senior career officials worked in what was widely viewed as an open process, including the participation of congressional staffs, to develop proposals. According to one of the architects of the proposals that eventually influenced the content of CSRA, the philosophy underlying the proposals was based on two objectives.²¹ The first was to “strip the system of its stultifying emphasis on detailed time-consuming processes so that managers were free to manage and the personnel community could focus on modernizing human resource management.” The second objective was to “put in place sufficient safeguards to minimize the new flexibilities being abused through discrimination or politicization of the career service.” Congress did not enact all of the proposals without modification. However, congressional hearings, legislative history, and statements of purpose revealed broadly similar sentiments.²²

Appointment of “Scientific and Professional” (ST) Personnel

After the Second World War, Congress authorized the Secretaries of War and the Navy to establish and fix the compensation for a limited number of highly paid positions in the “professional and scientific service,” subject to the approval of the Civil Service Commission (the precursor agency to today’s OPM).²³ This type of position, later renamed “scientific and professional,”²⁴ eventually proliferated to other departments in agency-specific allocations of positions.²⁵ Eventually codified at 5 U.S.C. § 3104,²⁶ and further amended, this authority requires the Director of OPM to allocate a finite number of these “ST” positions among agencies. According to OPM’s description, “[t]he Scientific or Professional (ST) personnel system covers non-executive positions classified above the GS-15 level that involve performance of high-level research and development in the physical, biological, medical, or engineering sciences, or a closely related field.”²⁷ The Senior Professional Performance Act of 2008 (P.L. 110-372) established a new pay system for scientific or professional employees.²⁸

²¹ Dwight Ink, “What Was Behind the 1978 Civil Service Reform?,” in *The Future of Merit: Twenty Years After the Civil Service Reform Act*, ed. James P. Pfiffner and Douglas A. Brook (Baltimore: Johns Hopkins University Press, 2000), p. 43. The initial proposals were developed by the Carter Administration’s “Personnel Management Project.”

²² P.L. 95-454, Sec. 3, “Findings and Statement of Purpose.” See also U.S. Congress, Senate Committee on Governmental Affairs, *Civil Service Reform Act of 1978 and Reorganization Plan No. 2 of 1978*, hearings, 95th Cong., 2nd sess., April and May 1978 (Washington: GPO, 1978); and U.S. Congress, House Committee on Post Office and Civil Service, *Civil Service Reform*, hearings, 95th Cong., 2nd sess., March, April and May 1978, H.Hrg. 95-65 (Washington: GPO, 1978).

²³ Act of August 1, 1947 (P.L. 313, 80th Congress; 61 Stat. 715).

²⁴ P.L. 758, 80th Congress; 62 Stat. 604.

²⁵ Federal Employees Salary Increase Act of 1958 (P.L. 85-462; 72 Stat. 203, at 213).

²⁶ P.L. 89-554, 80 Stat. 378 (1966).

²⁷ U.S. Office of Personnel Management, <http://www.opm.gov/ses/recruitment/stpositions.asp>.

²⁸ The new pay system also covers another group of employees classified above the GS-15 level, called “senior level” or “SL” employees. For more information about the pay of SL and ST employees, see CRS Report RL33245, *Legislative, Executive, and Judicial Officials: Process for Adjusting Pay and Current Salaries*, by Barbara L. Schwemle.

Demonstration Projects

In the late 1970s, one of the proposals that was submitted for congressional consideration as part of CSRA focused on “new approaches” to personnel management. Specifically, the Administration urged new statutory authority to pilot test new management techniques. According to one account, however, “Congress was wary of steps that might provide an opening wedge for new ways in which to undermine the merit system ... and enacted only a very limited version.”²⁹ This reference is most likely to the CSRA’s provisions related to “Personnel Research Programs and Demonstration Projects,” which were codified in Chapter 47 of Title 5.³⁰ These provisions have direct relevance to the federal S&T workforce. Some of the resulting demonstration projects, which colloquially are known as “demos,” are briefly discussed below.

Some of the most prominent demonstration projects that subsequently were authorized by OPM under Chapter 47 of Title 5 are well known in the human resources community. Congress made some of the demonstration projects permanent. These include the U.S. Navy’s “China Lake” demo, which was converted to a permanent system in 1994 by Section 342 of the National Defense Authorization Act for Fiscal Year 1995 (P.L. 103-337). A demonstration project at the National Institute of Standards and Technology (NIST), located within the DOC, was extended indefinitely by Section 10 of the National Technology Transfer and Advancement Act of 1995 (P.L. 104-113).

Other demonstration projects are currently active, including projects at DOC, for the civilian acquisition workforce of DOD, and at eight DOD science and technology laboratories (“DOD Lab Demos,” also authorized by Section 342 of P.L. 103-337). For example, in FY1999 (P.L. 105-261, Sec. 246) and FY2000 (P.L. 106-65, Sec. 245), and again in FY2003 (P.L. 107-314, Sec. 241), Congress authorized the Secretary of Defense to carry out three-year pilot programs aimed at revitalizing DOD laboratories and test and evaluation centers.³¹ The first of these authorizations focused on improved cooperative relationships with universities and private sector entities. The second included authority to experiment with human capital innovations that would allow laboratories and centers to compete in the hiring of skilled permanent and temporary personnel. The third extended these first two and authorized a third pilot program similar to the first two.

In its report on the FY2003 Defense Authorization bill, the Senate Armed Services Committee recommended that the Government Accountability Office (GAO) report on the status of these pilot programs.³² GAO found that of 178 initiatives proposed under these authorities, only 4 were implemented. One of the primary reasons for the low implementation, according to GAO, was many of the proposed human capital initiatives would have required waiving Title 5 provisions. It was the opinion of many DOD lawyers that the authority granted to conduct the pilot programs did not include authority to waive Title 5 requirements. One of DOD’s responses to the GAO report was the National Security Personnel System (NSPS), which had not yet been passed by Congress.³³ DOD indicated that NSPS would allow such waivers and make the pilot programs unnecessary.

²⁹ Dwight Ink, “What Was Behind the 1978 Civil Service Reform?,” in *The Future of Merit*, p. 45.

³⁰ P.L. 95-454, Section 601 (92 Stat. 1185), amending Title 5 to add a new chapter 47 (codified at 5 U.S.C. § 4701 et seq.).

³¹ These may be found at 10 USC 2538, Notes.

³² Government Accountability Office, *Defense Pilot Programs: DOD Needs to Improve Implementation Process for Pilot Programs*, GAO-03-861 July 28, 2003, <http://www.gao.gov/products/GAO-03-861>.

³³ NSPS eventually was established by P.L. 108-136; 117 Stat. 1621 (codified at 5 U.S.C. § 9902). For an overview of NSPS, see U.S. Congressional Budget Office, *A Review of the Department of Defense’s National Security Personnel*

Until 2007, basic information about demonstration projects was fairly time-consuming or difficult to acquire. However, OPM now has a website that contains information and reports about its demonstration project program and individual demos.³⁴

As discussed later, subsequent years would bring a proliferation of statutory authorities that were geared to agency-specific S&T workforces. Changes in executive-branch-wide authorities continued, as well, with either intended or potential relevance for S&T employees.³⁵

Intergovernmental Mobility (IPA)

CSRA also expanded authority under what has been called the Intergovernmental Mobility Program.³⁶ This authority originally was included as a title of the Intergovernmental Personnel Act of 1970 (IPA).³⁷ CSRA modified the authority to allow temporary assignment of personnel between the federal government and “any other organization,” with potential implications for employee recruitment and retention. In colloquial parlance, this CSRA-introduced authority oftentimes is referred to as the IPA.

The IPA is used by a number of agencies to enhance their S&E workforces. For example, at the NSF, approximately 10% (170-180) of the current NSF workforce is composed of temporary employees hired through this authority.³⁸ IPAs are known as rotators: they are considered to be federal employees while working at NSF; however, they continue to remain as employees of their home institutions.³⁹ IPAs are not paid directly by NSF; and as a result, are not subject to federal pay benefits and limitations. NSF reimburses the home institution of the IPA’s salary and benefits using the guidelines of the traditional grant mechanism. In addition, IPAs are eligible to receive per diem, relocation expenses, and reimbursement for any “lost” income resulting from their assignment at NSF (i.e., lost consulting fees). According to NSF,

Initial assignments [IPA] may be made for up to two years and may be intermittent, part-time or full time. Assignments may be extended at the request of NSF for up to three years. An extension to four years requires approval of NSF’s Deputy Director. By law, an IPA assignment may not be extended beyond four years.... It is NSF’s expectation that IPA

System, November 2008, <http://www.cbo.gov>.

³⁴ OPM’s overall demonstration project website is available at <http://www.opm.gov/demos/>. In December 2008, OPM published a report on the status of demonstration projects. See U.S. Office of Personnel Management, *Alternative Personnel Systems in the Federal Government: A Status Report on Demonstration Projects and Other Performance-Based Pay Systems*, HCLMSA-2008-005, December 2008, at <http://www.opm.gov/aps/reports/2008APSSStatusReport.pdf>. Additional information about specific demos is available at <http://www.opm.gov/demos/demofact.asp>.

³⁵ John D. Moteff, Specialist in Science and Technology Policy, prepared part of this section.

³⁶ P.L. 95-454, Section 603, 92 Stat. 1190.

³⁷ P.L. 91-648; 84 Stat. 1909. For more information about the Intergovernmental Mobility Program and IPA, see “Intergovernmental Personnel Act of 1970,” by Keith Bea, in CRS Report RL30795, *General Management Laws: A Compendium*, by Clinton T. Brass et al.

³⁸ U.S. National Science Foundation, FY2009 Budget Request to Congress, February 4, 2008, p. Stewardship-2.

³⁹ In addition, a smaller number of NSF visiting staff (approximately 40 employees annually) are employed through NSF’s Visiting Scientist, Engineer, and Educator Program (VSEE). VSEEs are counted as a federal FTE. Both IPAs and VSEEs at NSF are commonly referred to as rotators, and have been used at the agency since its beginning. VSEEs, however, do receive a salary directly from NSF (through the Agency Operations and Award Management account), although they continue to receive benefits through their home institutions, which are reimbursed by NSF.

assignees will not be employed by NSF in any capacity for at least one year upon completion of their IPA assignment.⁴⁰

During their employment at NSF, rotators assume the responsibilities and operate in a manner analogous to NSF's permanent staff—leading the merit review process, overseeing and managing awards, and developing and designing future program directions. In order to provide a smooth transition for rotators, the NSF Academy organizes training activities and off-site program management seminars several times each year for new rotators and permanent staff.⁴¹

Critical Position Pay Authority

FEPCA included provisions that provided a new pay authority for “critical positions.”⁴² Codified at 5 U.S.C. § 5377 and subsequently amended, OPM has provided this summary of the provision:

OPM may, upon the request of an agency head, and after consultation with the Office of Management and Budget (OMB), grant authority to fix the rate of basic pay for one or more critical positions in an agency at not less than the rate that would otherwise be payable for that position, up to the rate for level I of the Executive Schedule under the critical pay authority. Under this same provision of law, a higher rate of pay may be established upon the President's written approval. To apply the critical pay authority, the position must require a very high level of expertise in a scientific, technical, professional, or administrative field and be crucial to the accomplishment of an agency's mission.⁴³

OPM's guidance to agencies concerning the usage of the authority appears consistent with congressional intent, as it was expressed in a House report accompanying legislation that ultimately was enacted as FEPCA. That report cited testimony before the House Committee on Post Office and Civil Service about how the National Institutes of Health (NIH) reportedly had retention problems with its research scientists due to low pay compared to nonfederal alternatives.⁴⁴ The House report stated the “Committee believes that the pay authority for critical positions will assist the Federal Government in competing for world class experts in scientific, technical, professional and administrative fields.”

Recruitment, Relocation, and Retention Incentives

FEPCA also provided authority for the use of recruitment, relocation, and retention incentives,⁴⁵ which have become known as the “three Rs” or “3Rs.” Codified at 5 U.S.C. §§ 5753-5754 and subsequently amended, the provisions authorize incentive payments of up to 25% of an employee's annual rate of basic pay to be made under certain conditions, or at a higher rate with OPM approval. Recruitment and relocation incentives may be paid if an agency determines a

⁴⁰ National Science Foundation, “Intergovernmental Personnel Act (IPA) Assignments”, July 10, 2008

⁴¹ Christine M. Matthews, Specialist in Science and Technology Policy, prepared part of this section.

⁴² P.L. 101-509; 104 Stat. 1427, at 1444. FEPCA was included as a general provision in Title V of the Treasury, Postal Service and General Government Appropriations Act, 1991 (104 Stat. 1389).

⁴³ U.S. Office of Personnel Management, *Human Resources Flexibilities and Authorities in the Federal Government*, HCLMSA-007, January 2008, p. 45, <http://www.opm.gov/omsoe/hr-flex/>. Implementing regulations are located at 5 C.F.R. § 535. Level I of the Executive Schedule corresponds to the pay level for Cabinet-level positions. For more information, see CRS Report RL33245, *Legislative, Executive, and Judicial Officials: Process for Adjusting Pay and Current Salaries*, by Barbara L. Schwemle.

⁴⁴ U.S. Congress, House Committee on Post Office and Civil Service, *Federal Employees Pay Comparability Act of 1990*, report to accompany H.R. 3979, 101st Cong., 2nd sess., September 21, 1990, H.Rept. 101-730 (Washington: GPO, 1990), pp. 29-30.

⁴⁵ P.L. 101-509; 104 Stat. 1458-1460.

position is likely to be difficult to fill in the absence of an incentive. Retention incentives may be paid if an agency determines the unusually high or unique qualifications of an employee or special need of the agency for the employee's services makes it essential to retain the employee and the employee would be likely to leave the federal service in the absence of a retention incentive.⁴⁶

Special Pay Rates

FEPCA also provided for "special pay authority."⁴⁷ Under 5 U.S.C. § 5305, OPM may establish higher rates of basic pay—special rates—for a group or category of positions in one or more geographic areas to address existing or likely significant handicaps in recruiting or retaining well-qualified employees. OPM may establish special rates for nearly any category of employee (e.g., by series, specialty, grade-level, and geographic area). Patent examiners and attorneys who work at the Patent and Trademark Office (PTO) in DOC, for example, have received special pay rates.

Direct Hire Authority

Following the terrorist attacks of September 11, 2001, provisions were included in the Homeland Security Act of 2002 to allow the hiring of individuals without regard to certain Title 5 hiring provisions.⁴⁸ Codified at 5 U.S.C. § 3304, direct hire authority requires that an agency give public notice of its intention to use the authority and that OPM has determined "there exists a severe shortage of candidates or there is a critical hiring need." In 2004, Congress authorized direct hire authority for certain federal acquisition positions.⁴⁹ Implementing regulations at 5 C.F.R. § 337 articulate in greater detail how agencies and OPM make such determinations. OPM maintains online resources related to direct hire authority.⁵⁰ In addition, OPM maintains a list of positions and agencies for which OPM has granted permission to use the authority.⁵¹

Agency-Specific Statutory Authorities

Beginning in the 1990s, agency-specific statutory authorities that provided agencies with additional flexibility proliferated. **Table 7** and the paragraphs below provide some illustrative, historical examples of agency-specific authorities that have focused on hiring and paying the federal S&T workforce. It is important to note that agencies may or may not decide to use these authorities. In addition, a law may allow an agency discretion to make changes to its personnel system through mechanisms other than statute, such as notice and comment rulemaking, internal regulations, and even memoranda.

In the wake of major failures with the Internal Revenue Service's (IRS's) investments in information technology systems, IRS received agency-specific critical pay authority in 1998.⁵²

⁴⁶ For more information about 3R incentives, see CRS Report R40031, *Federal Employee Awards and Incentives: Title 5 Authorities and Potential Issues for Congress*, by Clinton T. Brass.

⁴⁷ P.L. 101-509; 104 Stat. 1427, at 1436.

⁴⁸ Section 1312 of P.L. 107-296; 116 Stat. 2290.

⁴⁹ Section 1413 of P.L. 108-136 (National Defense Authorization Act for Fiscal Year 2004), as extended by Section 853 of P.L. 110-181 (National Defense Authorization Act for Fiscal Year 2008).

⁵⁰ <http://www.opm.gov/directhire/index.asp>

⁵¹ http://www.opm.gov/hr_practitioners/lawsregulations/appointingauthorities/index.asp#directhire

⁵² Section 1201 of P.L. 105-206 (Internal Revenue Service Restructuring and Reform Act of 1998), codified at 5 U.S.C. § 9502.

Another agency that received critical pay authority (in addition to other personnel-related authorities) was the National Aeronautics and Space Administration (NASA).⁵³

Other authorities appeared to be influenced by flexibilities that were given to an agency within DOD. The Defense Advanced Research Projects Agency (DARPA) received statutory authority in 1998 that provided flexibilities similar to critical pay and direct hire authorities, albeit with different restrictions.⁵⁴ Subsequently, a number of additional authorities were enacted. For example, Section 307 of the Homeland Security Act of 2002 established the Homeland Security Advanced Research Projects Agency (HSARPA). The authority explicitly “piggybacked” on the DARPA authority, for purposes of “hiring and management authorities.”⁵⁵

Section 1101 of the National Defense Authorization Act for Fiscal Year 2004 authorized the creation of a new human resources management system for DOD, called the National Security Personnel System (NSPS).⁵⁶ Implementation of NSPS subsequently focused some attention on the department’s S&T workforce. In the same section, another provision was included, codified as 5 U.S.C. § 9903 (“Attracting highly qualified experts”) that effectively applied flexibilities similar to DARPA’s personnel provisions DOD-wide, albeit subject to different restrictions.⁵⁷

In 2006, Section 401 of the Pandemic and All-Hazards Preparedness Act established the Biomedical Advanced Research and Development Authority (BARDA), within the Department of Health and Human Services (HHS), with personnel provisions explicitly piggybacked on DOD’s authority under 5 U.S.C. § 9903.⁵⁸

Section 5012 of the America COMPETES Act (P.L. 110-69) established the Advanced Research Projects Agency—Energy (ARPA-E) within the Department of Energy (DOE).⁵⁹ The act did not piggyback on personnel provisions for DARPA or DOD under 5 U.S.C. § 9903, but provided the agency’s director with considerable hiring and pay flexibility.

⁵³ Section 3(a) of P.L. 108-201 (NASA Flexibility Act of 2004); 118 Stat. 461. An examination by GAO found that “[s]ince receiving its expanded human capital flexibilities, NASA has steadily increased its use of term appointments when hiring new employees. Subsequently, NASA has increased the number of conversions from term to career or career-conditional appointments. From 2003 through 2007, the majority of employees who separated from NASA voluntarily retired. Less than 1% separated because the employee’s appointment expired.” U.S. Government Accountability Office (GAO), *NASA Workforce: Briefing on National Aeronautics and Space Administration’s Use of Term Appointments*, GAO-08-920R, September 10, 2008, <http://www.gao.gov/new.items/d08920r.pdf>.

⁵⁴ Section 1101 of P.L. 105-261 (National Defense Authorization Act for Fiscal Year 1999); 112 Stat. 2139.

⁵⁵ 116 Stat. 2169.

⁵⁶ P.L. 108-136; 117 Stat. 1621; codified at 5 U.S.C. § 9902.

⁵⁷ 117 Stat. 1632; codified at 5 U.S.C. § 9903.

⁵⁸ P.L. 109-417; 120 Stat. 2865; codified at 42 U.S.C. 247d-7e.

⁵⁹ 121 Stat. 572, at 623. For more information on ARPA-E, see CRS Report RL34497, *Advanced Research Projects Agency - Energy (ARPA-E): Background, Status, and Selected Issues for Congress*, by Deborah D. Stine.

Table 7. Illustrative Agency-Specific Federal S&T Personnel Hiring and Pay Authorities

Department or Independent Agency	Agency or Statutory Authority	Illustrative Key Elements	Statutory Citation
Department of Defense (DOD)	National Security Personnel System (NSPS) ^a	NSPS replaces the current General Schedule (GS) classification system with Career Groups, Pay Schedules, and Pay Bands. The Scientific and Engineering Career Group is one of four career groups. This group is 20% of the DOD workforce. Positions in the career groups are further broken out by separate pay schedules based on similarities in the type of work being performed, knowledge or skill required, and pay ranges. Scientists and engineers are in the Professional pay schedule. Each pay schedule has two to four pay bands providing a natural progression from entry/developmental to journey and expert levels of work. ^b	5 U.S.C. § 9902
DOD	Hiring and pay for “highly qualified experts” ^c	Allows term appointments of up to five years. The total number of highly qualified experts is limited to 2,500 at any time. ^d	5 U.S.C. § 9903
DOD	Defense Advanced Research Agency (DARPA)	DARPA’s hiring authority allows it to directly hire up to 40 eminent scientists and engineers from outside government service for term appointments with DARPA for up to four years with possible extensions to six years. This streamlines and expedites the hiring process as the authority provides DARPA with an exemption from traditional Title V civilian personnel requirements. The authority also influences the compensation level of employees and provides the ability to provide bonuses to employees. ^e	Sec. 1101 authority (P.L. 105-261, amended by P.L. 110-181 to include “scientific and engineering positions in the Office of the Director of Defense Research and Engineering”; 5 U.S.C. § 3104 note)
Department of Homeland Security (DHS)	Homeland Security Advanced Research Projects Agency (HSARPA)	HSARPA was provided the same authority as DARPA, but the term appointment limit is five years instead of four years.	6 U.S.C. § 187 (Sec. 307 of P.L. 107-296; a DARPA “piggyback”)
Department of Health and Human Services (HHS)	Biomedical Advanced Research and Development Authority (BARDA)	The HHS Secretary has the same authority as the DOD Secretary in Section 9903 of Title 5 to take actions to attract “highly qualified experts” ^c for BARDA including determining the compensation level, with consideration of civil service pay scales. A maximum of 100 individuals, or 50% of the total number of employees, may be hired under this provision. Appointments may not exceed 5 years with an option for a one year extension. Current civil service employees are not eligible.	42 U.S.C. § 247d-7e (Sec. 401 of P.L. 109-417, a piggyback of DOD’s authority to attract “highly qualified experts” under 5 U.S.C. § 9903)
HHS	Public Health Service Commissioned Corps	The U.S. Public Health Service Commissioned Corps consists of 6,000 public health professionals who promote public health promotion and prevent disease. Corps officers may apply to a variety of positions throughout the U.S. Department of Health and Human	The Public Health Service origins began in the “Act for the Relief of Sick and Disabled Seamen”

Department or Independent Agency	Agency or Statutory Authority	Illustrative Key Elements	Statutory Citation
		Services (HHS) and certain non-HHS Federal agencies and programs in the areas of disease control and prevention; biomedical research; regulation of food, drugs, and medical devices; mental health and drug abuse; health care delivery; and international health. ^f	passed by Congress in 1798. ^g
Department of Energy (DOE)	Advanced Research Projects Agency – Energy (ARPA-E)	The ARPA-E director has hiring authority to make appointments of scientific, engineering, and professional personnel outside the civil service system, and determine the compensation of personnel. Personnel appointments are three years and may be renewed. The director may hire a private recruiting firm to hire technical staff.	42 U.S.C. 16538 (Sec. 5012 of P.L. 110-69)
National Aeronautics and Space Administration (NASA)	NASA	<p>Pay Authority For Critical Positions (§ 9807) may be used only when necessary to recruit or retain an exceptionally well-qualified individual for a position that requires expertise of an extremely high level in a scientific, technical, professional, or administrative field. The position must be critical to successful accomplishment of an important mission, and meet a critical need, as defined in NASA’s Workforce Plan. This authority is limited to ten employees at any one time.</p> <p>Recruitment bonus is paid to an individual newly appointed as an employee. A redesignation bonus is paid to an employee of another federal agency who is appointed to a NASA position in the same geographic area.</p> <p>Distinguished Scholar Appointing Authority (§ 9810) may be used to fill scientific and professional positions at grades GS-07 through GS-12. Candidates must meet the relevant OPM qualification standards for the position based upon education alone and have received the qualifying degree from an accredited university within two years of the effective date of the appointment. In addition, candidates must meet specified academic requirements at the time of graduation.</p>	<p>NASA Flexibility Act of 2004 (P.L. 108-201)</p> <p>“Pay authority for critical positions”: 5 U.S.C. § 9807 (Sec. 3(a) of P.L. 108-201)</p>
Department of Treasury	Internal Revenue Service (IRS)	IRS’s critical position pay authority provides that when the IRS seeks OPM’s approval for critical pay under 5 U.S.C. § 5377, IRS may fix the rate of basic pay up to the level of the Vice President (set according to 3 U.S.C. § 104). ⁱ	“Pay authority for critical positions”: 5 U.S.C. § 9502 (Sec. 1201 of P.L. 105-206)
DOC	National Institutes for Standards and Technology (NIST)	<p>There are four major pay systems at NIST: NIST Alternative Personnel Management System (APMS), Executive-Level Pay (SES and ST employees), Experts and Consultants, and the Federal Wage System (FWS).</p> <p>The NIST Alternative Personnel Management System (APMS) classifies NIST positions according to career path and pay band, instead of by GS grade. Career paths are categories of occupations grouped by similarities in work, qualification requirements, pay ranges, and career progression. The four career paths are Scientific and Engineering (ZP), Scientific and</p>	<p>The NIST Authorization Act for Fiscal Year 1987 (P.L. 99-574) established the NIST Personnel Management Demonstration Project to demonstrate an alternative personnel</p>

Department or Independent Agency	Agency or Statutory Authority	Illustrative Key Elements	Statutory Citation
		Engineering Technician (ZT), Administrative (ZA), and Support (ZS). Supervisory differentials are implemented in two ways: (1) by providing higher band ceilings for supervisors in all career paths (6% in most instances), and (2) by increasing the base salaries of new supervisors (3%) and division chiefs (additional 3%) in the Scientific and Engineering (ZP) Career Path. ST-3104 positions are specially designated positions involved in high-level scientific research activities. ST-3104 pay is determined by the Office of the Secretary of Commerce. The minimum payable rate for ST-3104 is 120% of step 1 of GS-15. The maximum rate is linked to Executive Level IV. Agencies may appoint a qualified expert or consultant to an expert or consultant position that requires only intermittent and/or temporary employment. Such an appointment is excepted from competitive examination, position classification, and the General Schedule pay rates. Federal Wage System employees are paid according to the GS schedule. ^j	management system. The Demonstration Project became a permanent system on March 7, 1996, through the National Technology Transfer and Advancement Act of 1995 (P.L. 104-113).
Department of Commerce (DOC)	Patent and Trademark Office (PTO)	PTO has special pay rates, which can be more than 25% above federal salaries for comparable positions, and bonuses that allows patent examiners to earn various cash awards for exceeding production goals. ^k	Granted by OPM under authority of 5 U.S.C. § 5305.
Nuclear Regulatory Commission (NRC)	NRC	While under Title 5 of the U.S. Code, NRC is also provided authority to depart from the code such as authorizing advances in pay for newly appointed employees and employment of experts and consultants. In the past, NRC requested authorization from OPM to use executive-branch-wide direct hire authority. OPM determined that NRC employees were not covered by the Title 5 direct hire provision. Pay setting authority allows NRC to set pay within limits prescribed by its statute. For example, NRC can establish rates for scientific and technical positions above the regular GS rates. In addition, NRC has special pay flexibility to appoint employees with superior qualifications to a higher step rate above the first step of their grade. Recruitment incentives of up to 25% of employee's pay are available to recruit highly qualified and competitive candidates. Also available are relocation and retention incentives, and service credit for annual leave. ^l	Atomic Energy Act of 1954, Section 161(d) (42 U.S.C. § 2201(d))

Source: Congressional Research Service.

Notes:

- a. For an overview of NSPS, see U.S. Congressional Budget Office, *A Review of the Department of Defense's National Security Personnel System*, November 2008, <http://www.cbo.gov>. For discussion of the NSPS pay-for-performance system, see CRS Report RL34673, *Pay-for-Performance: The National Security Personnel System*, by Wendy R. Ginsberg.
- b. National Security Personnel System, Classification Architecture Fact Sheet, November 2007, at <http://www.cpms.osd.mil/nsps/docs/factsheets/classificationarchitecture032508.pdf>.

- c. DOD defines a highly qualified expert (HQE) as “An individual who possess uncommon knowledge and recognized knowledge, skills, and experience in an occupational field, and judgment that is accorded authority and status by peers or the public. An HQE has substantive experience and/or education, is generally credentialed, and has prove ability in a particular field or fields.” David S.C. Chu, Undersecretary of Defense, Department of Defense, “Revised Policy – Employment of Highly Qualified Experts,” Internal Memorandum, June 27, 2006, http://www.cpol.army.mil/library/nonarmy/dod_062706.html.
- d. DOD’s undersecretary for personnel and readiness subsequently issued a memorandum that provided guidance on policies and procedures for appointing and compensating the highly qualified experts, which later was superseded by another memorandum. David S.C. Chu, Undersecretary of Defense, Department of Defense, “Employment of Highly Qualified Experts,” Internal Memorandum, February 27, 2004, <http://www.per.hqsareur.army.mil/CPD/Employment/docs/DODEmploymentofHighlyQualifiedExperts.pdf>.
- e. This option has been available to DARPA since FY1999. Despite this authority, DARPA has difficulty in filling its scientific and technical positions, and approving its contract awards, leading it to underexecute its programs according to an internal DOD reprogramming action. Department of Defense, Reprogramming Action, Defense Wide Operational Requirements at http://blog.wired.com/defense/files/2008_06_18_13_34_231.pdf.
- f. In August 2008, the Assistant Secretary for Health approved a two-year pilot initiative to increase the number of medical officers in the Commissioned Corps. The purpose of the pilot is to increase the number of highly qualified, experienced physicians to meet the increasing demands of the Service by utilizing specific accession practices and policies. Although the Commissioned Corps as a whole has grown in size over the past year, the medical category has continued to experience decreasing numbers. Among its provisions, the pilot program: allows inter-service transfers for a limited number of eligible members, and commissioning of a limited number of qualified civilians at the O-5 rank.
- g. For more information, see <http://commcorps.shs.net/aboutus/history.aspx>.
- h. An examination by GAO found that “Since receiving its expanded human capital flexibilities, NASA has steadily increased its use of term appointments when hiring new employees. Subsequently, NASA has increased the number of conversions from term to career or career-conditional appointments. From 2003 through 2007, the majority of employees who separated from NASA voluntarily retired. Less than 1% separated because the employee’s appointment expired.” U.S. Government Accountability Office (GAO), *NASA Workforce: Briefing on National Aeronautics and Space Administration’s Use of Term Appointments*, Memorandum, GAO-08-920R, September 10, 2008, <http://www.gao.gov/new.items/d08920r.pdf>.
- i. Senators Max Baucus and Charles Grassley, chairman and ranking member of the Senate Finance Committee, wrote a letter to Paul B. Jones, Chairman of the IRS Oversight Board, asking the Board to provide answers to several questions to enable the committee to assess the effectiveness of the IRS critical pay authority. Senators Max Baucus, Chairman, and Charles Grassley, Ranking Member, Senate Finance Committee, letter to Paul B. Jones, Chairman, Internal Revenue Service Oversight Board, August 15, 2007, <http://finance.senate.gov/press/Bpress/2007press/prb081507.pdf>.
- j. For more information, see <http://www.nist.gov/hrmd/compensation/paysystems.htm#Experts>. In Congressional testimony, a deputy director of NIST stated “NIST competes more effectively in the labor market through more efficient and faster staffing mechanisms, such as direct hire authority, more direct management involvement in recruiting and hiring, flexible entry salaries, recruiting allowances, and more flexible paid advertising. Since implementing the Alternative Personnel Management System, according to findings in the Office of Personnel Management’s “Summative Evaluation Report National Institute of Standards and Technology Demonstration Project: 1988-1995,” NIST is more competitive for talent; NIST retained more top performers than a comparison group; and NIST managers reported significantly more authority to make decisions concerning employee pay.” Testimony of Dr. Hratch G. Semerjian, Deputy Director, National Institute of Standards and Technology, Technology Administration, U.S. Department of Commerce, Before the Subcommittee on Oversight of Government Management, the Federal Workforce and the District of Columbia, Senate Committee on Homeland Security and Government Affairs, “Alternative Personnel Systems: Assessing Progress in the Federal Government”, September 27, 2005, <http://www.ogc.doc.gov/ogc/legreg/testimon/109fiSemerjian0927.htm>.
- k. A GAO study found that although the incentives were the reason employees came to, and stayed with PTO, along with flexible work policies, USPTO still had challenges retaining employees. While agency management indicate staff left for personal reasons, USPTO staff state it is the overly ambitious agency production goals that require unpaid overtime. GAO, *U.S. Patent And Trademark Office: Hiring Efforts Are Not Sufficient to Reduce the Patent Application Backlog*, GAO-07-1102, September 2007, <http://www.gao.gov/new.items/d071102.pdf>. Senators Max Baucus, Chairman, and Charles Grassley, Ranking Member, Senate Finance Committee, letter to Paul B. Jones, Chairman, Internal Revenue Service Oversight Board, August

15, 2007, <http://finance.senate.gov/press/Bpress/2007press/prb081507.pdf>. The letter asked the Board to provide answers to several questions, to enable the committee to assess the effectiveness of the IRS critical pay authority

- I. According to the GAO, “NRC has been effective in recruiting, developing, and retaining a critically skilled workforce to date, yet it is unclear whether this trend will continue in the next few years.” GAO, Human Capital: Retirements and Anticipated New Reactor Applications Will Challenge NRC’s Workforce, GAO-07-105, January 2007, <http://www.gao.gov/new.items/d07105.pdf>. Appendix V provides a comprehensive list of NRC’s use of human capital flexibilities, authorities, tools, and programs including an assessment by NRC managers of the utility of each mechanism.

What are Some Possible Policy Options for Recruiting and Retaining the Federal S&T Workforce?

A number of organizations have analyzed the federal S&T workforce. These reports have identified some possible policy options that Congress and federal agencies might consider undertaking in order to better recruit and retain the federal S&T workforce.

National Research Council

In 1990, the National Research Council (NRC) prepared a report entitled *Recruitment, Retention, and Utilization of Federal Scientists and Engineers* for the Carnegie Commission on Science, Technology, and Government.⁶⁰ This report, chaired by a former director of OPM and the Civil Service Commission, found that “[p]erceptions about factors affecting the federal government’s ability to recruit and retain scientists and engineers have remained basically the same for the past 30 years, in spite of specific efforts by OPM and individual federal agencies to enhance such recruitment and retention.” **Figure 9** provides the barriers the report identified and the mechanisms proposed to reduce them. The report also found that

To fulfill the missions of federal agencies, science and engineering activity can be undertaken under a variety of scenarios—including the traditional setting within an agency, demonstration projects, federal laboratories, and managed-and-operated (M&O) facilities. Demonstration projects authorized by OPM and the contracting out of S&E work seem to have provided agencies with the flexibility deemed necessary to overcome some of the difficulties associated with recruitment, retention, and utilization of scientists and engineers.⁶¹

⁶⁰ National Research Council, *Recruitment, Retention, and Utilization of Federal Scientists and Engineers* (Washington, DC: National Academy Press, 1990), <http://www.nap.edu/catalog/1603.html>.

⁶¹ Ibid.

Figure 9. Barriers to Effective Recruitment and Retention of Scientists and Engineers and Mechanisms to Reduce Them

Barriers	Mechanisms
Inadequate compensation	Pay banding, recruitment bonuses, occupation specific pay scales.
Lengthy time required to extend an offer of employment	Direct-hire authority, simplified hiring procedures, increased personnel authority for line managers.
Difficulty of promotion after reaching GS-12 level	Pay banding.
Restricted role of line managers in personnel decisions	Flexibility in increasing salary without promoting, increasing personnel authority for line managers, occupation-specific salary schedules.
Excessive paper work	Direct-hire authority, computer-assisted classifications, more generic classifications.
Questionable tie between performance and pay	Performance appraisals and multiple components of pay increase that are not mutually exclusive; bonuses; awards
Personnel ceilings and reductions in force	Using adjunct personnel such as postdocs; flexibility in considering force factors other than seniority; simplified classification systems that enable the labs to retrain RIFed staff.

Source: National Research Council, *Recruitment, Retention, and Utilization of Federal Scientists and Engineers* (Washington, DC: National Academy Press, 1990), <http://www.nap.edu/catalog/1603.html>.

A follow-up to this report, released in 1993, entitled *Improving the Recruitment, Retention, and Utilization of Federal Scientists and Engineers*, discussed recruiting requirements, challenges in coping with the civil service system, federal pay reform, and issues such as who should be responsible for federal S&Es, how the effectiveness of the current system should be evaluated, and special provisions for administering the S&E workforce.⁶² Among the report's recommendations are the following:

- The pay reform provisions and related flexibilities provided by FEPCA should be implemented as fully as possible by the President and the departments and agencies, in order to redress pay inequities and reward superior performance among all federal employees, including scientists and engineers.
- OPM should follow its aggressive effort to delegate its authorities under FEPCA with an equally strong effort to see that FEPCA authorities and flexibilities are decentralized to the appropriate levels within the departments and agencies.
- To help carry out its responsibilities for encouraging, assisting, and overseeing the departments and agencies, OPM should develop an organizational focus for science and engineering personnel policy staffed by individuals who have had experience as senior managers of scientists and engineers.
- Each federal agency with a science and engineering workforce should develop a comprehensive action plan, with assistance from OPM, to (1) identify agency goals and develop an appropriate science and engineering staffing plan, and (2) use the authorities provided under FEPCA to improve recruitment, retention, and utilization of scientists and engineers.
- A new interagency committee on federal scientific and engineering personnel should be established in the Executive Office of the President under the Federal

⁶² National Research Council, *Improving the Recruitment, Retention, and Utilization of Federal Scientists and Engineers* (Washington, DC: National Academy Press, 1993), http://www.nap.edu/catalog.php?record_id=2102.

- Coordinating Council on Science, Engineering, and Technology (FCCSET)⁶³ to (1) evaluate and recommend science and engineering personnel policies and their implementation; (2) develop model strategies for combining the relevant flexibilities in FEPCA and for science and engineering personnel program evaluation; (3) share successful and unsuccessful experiences; (4) monitor the overall success of the government in recruiting and retaining scientists and engineers across agencies; and (5) provide a forum for identifying and working out solutions to common problems.
- Congress and the executive branch should work together to make further changes in the civil service system that address the problems beyond pay flexibility per se. Meanwhile, Congress and OPM should continue the personnel demonstrations as testbeds for policies and practices that are not necessarily permitted under FEPCA or other federal personnel laws.⁶⁴

RAND Science and Technology Policy Institute

In 2004, the RAND Science and Technology Policy Institute (STPI) prepared a report entitled *Will the Scientific and Technology Workforce Meet the Requirements of the Federal Government?* for the President's Office of Science and Technology Policy (OSTP).⁶⁵ This report provides an overview of the federal workforce, discusses the status of data on that workforce, and proposes possible mechanisms for change. Some of the findings include:

- Workforce incentives are becoming more prominent as a way of attracting and retaining high-quality STEM workers. Some agencies have had success with these techniques and others anticipate using them more aggressively. NASA and the Centers for Disease Control and Prevention (CDC), for example, have obtained special authority from OPM to offer salaries above typical federal rates.
- A significant proportion of STEM [scientific, technical, engineering, and mathematics] workers employed on federal projects work in fact for private-sector contractors. This mechanism allows the government to reach flexibly into the private sector for more or fewer STEM workers as the requirements change. Accordingly, the workforce constraints become the size and characteristics of the entire national STEM workforce, not just those who choose to be government employees.⁶⁶

Many of the mechanisms that are proposed are focused on activities on “filling the pipeline”—measures to attract students into the science and engineering workforce through educational policy mechanisms. The other set of mechanisms proposed entitled “shaping the workforce” are focused on adjusting the labor pool through immigration measures, and adjusting the workforce through federal agency mechanisms to recruit, retain, and promote the STEM workforce. The RAND STPI analysis focuses on OPM authorizing NASA to offer hiring bonuses, the NIH

⁶³ Note that since this report was released, FCCSET was subsumed by the National Science and Technology Council managed by the President's Office of Science and Technology Policy. For more information, see CRS Report RL34736, *The President's Office of Science and Technology Policy (OSTP): Issues for Congress*, by Deborah D. Stine.

⁶⁴ Ibid.

⁶⁵ William P. Butz, Terrence K. Kelly, David M. Adamson, Gabrielle A. Bloom, Donna Fossum, and Mihal E. Gross, *Will the Scientific and Technology Workforce Meet the Requirements of the Federal Government?*, RAND Corporation, Science and Technology Policy Institute, 2004, <http://www.rand.org/pubs/monographs/MG118/index.html>. Note that STPI, a federally-funded research and development center, is currently managed by the Institute for Defense Analysis, not the RAND Corporation.

⁶⁶ Ibid.

program to repay outstanding student loans for health researchers, and the development by the Center for Disease Control (CDC) of programs to train health professionals. In assessing the effectiveness of the various mechanisms, STPI found that current federal initiatives emphasized filling the pipeline, and that federal agencies were just beginning to use workforce shaping mechanisms.

Jason Committee

In October 2008, a Jason⁶⁷ committee provided a report to DOD entitled *S&T for National Security*. This report is not classified; however, the DOD has not yet decided to release it to the public. Powerpoint slides provided by DOD summarizing this report and discussions with the director of the Jason⁶⁸ program office indicate that the report states that the science and engineering civilian and military workforce are not obtaining sufficient recognition within the DOD, while other professions such as attorneys and health professions are receiving such recognition because they have their own corps. Of particular concern are military personnel who, in order to be promoted, must undertake non-science/engineering duties.

The report recommends that DOD enhance its recruitment and retention policies for its S&T personnel. One option proposed is that DOD establish a research corps within each Service (Air Force, Army, etc.) that would include military and civil service researchers at DOD laboratories and research agencies. This option is based on an existing program, the Service's medical corps, which has its own line of authority including a General responsible for managing its operation. The Jason report states that this research corps might enhance professionalism, training, career paths, DOD-wide mobility, visibility, and esprit of DOD's research staff.

What Factors Might Be Considered in Selecting Policy Options?

Human resource management issues relating to S&T personnel have been of ongoing concern to Congress, both government-wide and for particular agencies. If Congress wishes to evaluate the ability of the federal government and its agencies to recruit and retain S&T personnel, the variety of statutory authorities provide illustrations of topics that might be examined. In addition, the federal government's experience with these statutory authorities might inform Congress's deliberations, if Congress wished to consider modifying the ability of the federal government to recruit highly-qualified scientific, engineering, and technical personnel.

In evaluating current efforts or considering future modifications, Congress may wish to consider factors that include the following:

- Given perceived problems regarding recruitment and retention of federal S&E personnel, agency-specific and executive-branch-wide approaches could be considered.
- If an executive-branch-wide approach were pursued, it may be possible to structure legislation to leverage the involvement of entities such as OPM, the

⁶⁷ Jason, established in 1960, is an independent scientific advisory group that advises the federal government, primarily on issues related to national defense. The Jason program office is located at the Mitre Corporation. A history of the Jason organization is available in Ann Finkbeiner, *The Jasons* (New York, NY: Viking Penguin, 2006).

⁶⁸ Personal Communication between CRS and Dan McMurrow, Director, Jason Office, Mitre, on December 1, 2009 and March 19, 2009.

federal Chief Human Capital Officers (CHCO) Council, OSTP, and OMB, in addition to agencies with S&E workforces themselves.

- Tools to galvanize action by agencies, OPM, and OMB might be pursued through several means, including requirements for strategic planning, coordination, evaluation, and solitary or joint reporting.
- Although many statutory authorities have focused on providing additional flexibilities to agencies, it is not clear how much accountability has been gained in exchange. A number of observers have, over extended periods, expressed concerns about the ability of OPM to effectively oversee agency use of these authorities.⁶⁹
- The goal of a number of programs is to recruit staff for term appointments of one to five years. However, if the goal is for an agency to build a long-term workforce who stay for more than five years, reliance on short-term appointments may not be an appropriate model. Further, even if an agency has the goal of building a shorter-term workforce of five years or less, prospective recruits may be unwilling to take a position that has a pre-determined endpoint, even if the rate of compensation is higher.
- Several of the programs only apply to a small number of individuals. If the goal is to recruit a large number of individuals, these may not be appropriate models.
- Although various recruiting mechanisms have been developed and are in active use, there is insufficient evidence as to whether or not these programs are likely to achieve a given employment goal. Some of the agencies continue to experience challenges in employing the personnel they need despite such programs.
- Some policies are targeted at entry-level employees, while others are targeted at more senior employees. Each may prefer different incentives. As a result, one factor to consider is whether or not the goal of a program is to recruit entry-level staff, senior staff, or both.

Obama Administration Actions

According to news reports, the OPM Director John Berry plans to pursue a significant reform of the civil service system in Title 5, including a pay for performance system, in response to concerns that the federal pay system is “balkanized to the point of a risk of failure.”⁷⁰ The three-pronged strategy, approved by President Obama, would “reform the law on federal employee pay: create a fair and credible performance appraisal and accountability system; develop training that would prepare employees for promotion and support them throughout their careers; and establish genuine parity between federal and private-sector salaries for employees in comparable occupations.”⁷¹

The Obama Administration has taken several actions related to federal S&E personnel actions. These include:

⁶⁹ For example, see Dwight Ink, “What Was Behind the 1978 Civil Service Reform?,” in *The Future of Merit*, p. 52.

⁷⁰ Alyssa Rosenberg, “Administration Will Push for Governmentwide Pay for Performance,” *Government Executive*, May 27, 2009 at http://www.govexec.com/story_page.cfm?filepath=/dailyfed/0509/052709ar1.htm&oref=search.

⁷¹ Ibid.

- Halting expansion of DOD's National Security Personnel System (NSPS) pending a review by the Obama Administration;⁷²
- Allowing federal agencies to use excepted service appointments to carry out provisions of the American Recovery and Reinvestment Act (ARRA; P.L. 111-5);⁷³
- Providing agencies with the ability to rehire annuitants (retired federal employees) to help carry out ARRA;⁷⁴ and
- Helping agencies identify specific workforce strategies, including special hiring flexibilities to meet ARRA requirements.⁷⁵

Activities in the 111th Congress

A draft energy research and development bill proposed by the chair and ranking member of the Senate Committee on Energy and Natural Resources would provide DOE with direct hire, critical pay, and rehire authority.⁷⁶ As described by the committee:

Section 47 – Direct Hire Authority. This section gives the DOE direct hire authority for a period of two years, such hiring must be consistent with merit principals [sic⁷⁷] and public notice. Such authority originally rested with the Atomic Energy Commission and was transferred to the Nuclear Regulatory Commission (NRC) but not the DOE. The NRC has recently used this authority to rapidly hire 400 engineers for the surge in nuclear plant license applications.

Section 48 – Critical Pay Authority. This section gives the DOE critical pay authority to hire up to 40 highly skilled individuals for key or critical mission positions at the Department for a period of no more than 4 years up to the salary of the Vice-President of the United States. This will enable DOE to attract highly qualified individuals from industry and academia for positions within the Department typical of science and engineering intensive missions.

Section 49 – Rehire Authority. This section gives the DOE the authority to rehire retired DOE employees for mission critical positions without impacting their retirement annuity. Many Department employees served in excess of 20 or 30 years in programmatic positions managing large, technically complicated energy related efforts. This authority will enable continuity of knowledge transfer as newer employees are hired.⁷⁸

⁷² Department of Defense, National Security Personnel System, “DoD and OPM Announce Review of National Security Personnel System,” <http://www.cpmis.osd.mil/nsps/>.

⁷³ Office of Personnel Management, “OPM Authorizes Excepted-Service Appointments to Support Recovery Act,” press release, March 17, 2009, <http://www.opm.gov/news/opm-authorizes-exceptedservice-appointments-to-support-recovery-act,1453.aspx>.

⁷⁴ Office of Personnel Management, “Rehiring Annuitants in Support of the American Recovery and Reinvestment Act of 2009,” March 16, 2009, <http://www.chcoc.gov/Transmittals/TransmittalDetails.aspx?TransmittalId=2132>.

⁷⁵ Office of Personnel Management, “OPM Convenes CHCO Council and Offers HR Aid to Agencies Implementing American Recovery and Reinvestment Act,” press release, March 12, 2009, <http://www.opm.gov/news/opm-convenes-chco-council-and-offers-hr-aid-to-agencies-implementing-american-recovery-and-reinvestment-act,1451.aspx>.

⁷⁶ Senate Committee on Energy and Natural Resources, “Energy Research and Development,” draft bill, at http://energy.senate.gov/public/_files/END09412_xml.pdf.

⁷⁷ The word “principles” is possibly meant here.

⁷⁸ Senate Committee on Energy and Natural Resources, “Energy Research and Development (Document END09412),” draft bill summary, at http://energy.senate.gov/public/_files/EnergyInnovationandWorkforceDevelopmentSectionbySection.pdf.

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